

# HIGHLIGHTS



## OF THE TECHNICAL SUPPORT PROJECT MEETING

A training meeting of EPA's Technical Support Project (TSP) was held May 1-3, 2012, in Oklahoma City, Oklahoma. Training covered a variety of site characterization and remediation topics, many of which took advantage of the expertise offered by scientists and engineers at the Ground Water and Ecosystems Restoration Division (GWERD), an EPA Technical Support Center (TSC) located in nearby Ada. Acting Director David Jewett provided an update on research at GWERD and delivered a keynote address on the laboratory's study of the environmental impacts of hydraulic fracturing, an issue that is gaining national attention and public concern. The training presentations highlighted the importance of the TSCs in providing RPMs with technical assistance at their sites, as well as the importance of RPMs and the TSP in shaping TSC research.

This *Highlights* newsletter summarizes these and other training topics from the meeting. If you are interested in additional information on these topics, please visit [www.epa.gov/tio/tsp/meetings.htm](http://www.epa.gov/tio/tsp/meetings.htm) to view the full presentations, or contact your regional TSP representatives listed on 12.

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## PLENARY PRESENTATIONS

### Research at EPA's Groundwater and Ecosystems Restoration Division (GWERD)

David Jewett provided an overview of the research being done by scientists at GWERD in Ada, Oklahoma. Ongoing research related to the protection and cleanup of groundwater includes:

- The use of flux or mass discharge measurements to characterize and manage contaminant source zones and their plumes.
- In situ chemical oxidation (ISCO) to treat organic contaminants.
- The use of emulsified zero-valent iron to enhance degradation of chlorinated solvents.
- Permeable reactive barriers for treating inorganics.
- Methods to monitor and confirm the monitored natural attenuation of inorganics.
- The subsurface transformation of chlorinated solvents.
- Aquifer vulnerability due to leaking underground storage tanks
- Software and models.

GWERD also is working on several research projects dealing with the restoration of ecosystems and mitigating the impacts of subsurface land use practices, including the potential impact of hydraulic fracturing on drinking water resources.



### EPA's Plan to Study the Potential Impacts of Hydraulic Fracturing on Drinking Water Resources

As directed by Congress in FY 10, EPA is studying the potential impacts of hydraulic fracturing on drinking water resources and identifying the driving factors that affect the severity and frequency of any impacts. David Jewett explained that GWERD is looking at impacts of the *entire* fracturing water cycle, which involves transport of water to the site, mixing with chemicals and sand, pumping of the fluid underground at high injection rates, recovery and storage of water, and treatment of the wastewater.

GWERD's research involves analyzing existing data; identifying case studies for field sampling, modeling, and parallel labora-

### Long-Time TSP Members Honored

Members of the TSP forums recognized the contributions of David Reisman of the National Risk Management Research Laboratory (NRMRL) in Cincinnati and Steve Mangion, Region 1's Superfund and Technology Liaison, with certificates of appreciation for their many years of leadership, commitment, and support to the forums. Both will be retiring from EPA this year. They will be missed!



*David Reisman receives his certificate of appreciation from Greg Gervais, Chief, Technology Assessment Branch.*

tory investigations; evaluating scenarios (including modeling failure scenarios to determine conditions under which contaminant migration may occur); conducting laboratory studies; and assessing toxicity using existing data on chemical, physical, and toxicological properties of fracturing fluids. A report of results for all but toxicity assessments is anticipated in 2012. Toxicity assessments are targeted for completion in 2014.

More information on the study and on fracturing for natural gas extraction can be found at [www.epa.gov/hydraulicfracturing/](http://www.epa.gov/hydraulicfracturing/).

### Panel Session on Technical Impracticability (TI) Waivers

Region 3, Region 6, and Headquarters staff collaborated to offer presentations and a panel session on TI waivers. Dave Turner (Region 3 RPM) and Kathy Davies (Region 3 hydrogeologist) used the UGI Columbia Gas Plant Superfund site as an example of a TI waiver obtained for groundwater ARARs (applicable or relevant and appropriate requirements). They presented the conceptual site model developed, detailing each of the TI evaluation components that led to the determination. During past gas plant operations, overflows from a coal tar relief holder were directed to an open ditch leading to the Susquehanna River, which contaminated site soil, groundwater (in a fractured bedrock setting), and river sediments with tar-related compounds. Following removal of source area soil and contaminated sediment and the recovery of some coal tar using the CROW (Contained Recovery of Oily Wastes) process, EPA's preferred alternative for groundwater included a TI waiver applied in the DNAPL zone, groundwater monitoring, and institutional controls (ICs) that restrict future

well placement and use. Cynthia Nadolski (Office of Regional Counsel) summarized some of the legal issues encountered in ensuring that the requirements of the TI waiver were satisfied.

In a second presentation, Raji Josiam (Region 6) explained challenges encountered in establishing the spatial extent of the TI zone, the area over which a TI decision applies, at the Petro-Chemical Systems Inc. Superfund site. A ROD amendment selected ISCO as the remedy with the TI zone established after two years of groundwater monitoring. The first TI zone proposed by the PRP was too large and did not meet the intent of EPA's *Interim Guidance for Evaluating the Technical Impracticability of Ground Water Restoration* (1993). The PRP redrew the boundary after consulting with Region 6 and Texas regulators on both EPA guidance and state requirements for TI zones.

EPA Headquarters requested further reducing the zone by basing it on the plume rather than the property boundary. The PRP proposed a new TI zone, and Region 6 and Texas have approved it along with a compliance boundary to verify compliance with ARARs and to verify that the plume has not migrated to compliance wells. The new TI zone applies to chemicals of concern that remain above cleanup levels and to both shallow and deeper groundwater zones. Raji summarized several lessons learned, emphasizing the importance of early discussions with EPA Headquarters to understand their expectations and balance them with the State requirements.

In closing, Matt Charsky (EPA/OSRTI) presented Headquarters' perspective on satisfying and documenting the requirements for TI waivers. He noted that the vast majority of TI waivers address groundwater restoration, and nearly 2/3 of these involve complex hydrogeology, such as fractured bedrock, karst terrain, heterogeneous soils with low permeability, and multiple aquifers. Matt indicated that Headquarters is looking into revising the 1993 guidance to incorporate issues such as redefining the TI boundary.

### Soil Vapor Extraction (SVE) Site Closure Criteria

Vince Malott (Region 6) discussed three sites with RODs that selected SVE to address threats to groundwater from VOCs in the vadose zone. Data from these sites highlight the difficulty in establishing exit strategies for the remedy. Vince examined RODs from several sites for help in establishing an exit strategy for his own site and found differences in remedy descriptions, objectives, and goals. The most common remedy objectives for SVE in RODs from other regions generally included reducing concentrations of soil contaminants to levels that no longer serve as a source of groundwater contamination, and preventing their migration to groundwater at concentrations that exceed leachability-based criteria. The performance of SVE systems at a number of sites was generally assessed using trend analysis, rebound testing and operation, and confirmatory soil sampling. Vince suggested that the forums collaborate on guidelines that assist RPMs in writing remedy descriptions, objectives, and performance measurements for inclusion in the ROD.

### Monitored Natural Attenuation (MNA) Remedy Selection at Hill AFB, Utah

Sandra Bourgeois (Region 8) and Mo Slam (Utah DEQ) described lessons learned in making the case for MNA at two operable units (OU) located at Hill Air Force Base (AFB) where VOC plumes extended into neighboring residential areas. In their review of the draft ROD for OU12, EPA Headquarters commented that it needed to either: 1) document that MNA was occurring for low levels of contaminants emerging downgradient of an existing PRB; or 2) require installation of a remedial system at the toe of the plume, which prompted follow-up studies to identify multiple lines of evidence to justify MNA. Citing a lack of multiple lines of evidence at OU 9, Headquarters also rejected the draft ROD in which MNA was the selected remedy. Sandra and Mo are now collaborating with John Wilson (GWERD) to properly evaluate MNA. They noted several lessons learned from the ROD rejection, including relying on empirical data rather than empirical analysis, performance-based remediation, and being "too close to" the site.

### TRAINING ON EPA'S ENVIRONMENTAL FOOTPRINT METHODOLOGY

Carlos Pachon (OSRTI), Julie Santiago (Region 9), Karen Scheuermann (Region 9), and Hilary Thornton (Region 3, on detail to Region 4) led a training course in the use of EPA's Methodology for Understanding and Reducing a Project's Environmental Footprint (available at [www.epa.gov/oswer/greenercleanups/methodology.html](http://www.epa.gov/oswer/greenercleanups/methodology.html)). The methodology analyzes and quantifies the environmental footprint of site cleanup activities, identifying the most significant contributors to a project's footprint to better focus efforts to reduce it. The course, being offered for the first time, included an interactive group exercise designed to help participants become familiar with the methodology and the data inputs. Karen provided an example application of the methodology to a pump-and-treat system and guided participants through each of the methodology's seven steps. She also explained how to interpret results, including identifying what is a big footprint and the parameters that affect it the most. At the end of the course,



Kristi Zakrzewski reports out from her environmental footprint workgroup.

Karen provided participants with an overview of the Spreadsheets for Environmental Footprint Analysis, which are available for download and use at [www.clu-in.org/greenremediation/methodology/index.cfm](http://www.clu-in.org/greenremediation/methodology/index.cfm). An updated version of the course is planned for the 2012 NARPM Training Program.

## USE OF ADVANCED TOOLS IN ENVIRONMENTAL INVESTIGATIONS

### Introduction to Compound-Specific Isotopes Analysis (CSIA)

Tomasz Kuder (University of Oklahoma) explained the chemistry of stable isotopes and how the stable isotopes of hydrogen ( $^1\text{H}/^2\text{H}$ ), carbon ( $^{12}\text{C}/^{13}\text{C}$ ), and chlorine ( $^{35}\text{Cl}/^{37}\text{Cl}$ ) can be useful in identifying contaminant sources and assessing contaminant degradation in environmental investigations. CSIA, a combination of chromatography and isotope ratio mass spectrometry, determines the isotopic ratios in a compound. Isotopic ratios vary among the many natural and manufactured compounds containing these elements. Distinguishing between these different ratios can aid in source tracking and identification. For example, CSIA was used to distinguish between vapor intrusion and indoor air sources of trichloroethene (TCE) in homes near Hill AFB. In addition, CSIA also can help assess remediation performance. The Rayleigh model of kinetic fractionation can be used to help understand whether biological degradation, chemical degradation, or diffusion of a contaminant is occurring based on the enrichment of one isotope relative to the other. One application used the Rayleigh model to evaluate whether the natural attenuation of methyl *tert*-butyl ether (MtBE) plumes was due to degradation or dilution.

### Role of Molecular Biological Tools during MNA and Active Remediation of Chlorinated Solvents Sites

John Wilson (GWERD) summarized a number of molecular biological tools (MBTs) that can help investigators identify the types of microorganisms present at a site and better understand the microbial processes relevant to assessing and remediating chlorinated solvent sites. MBTs target “biomarkers,” which are specific nucleic acid sequences, peptides, proteins, and lipids in microorganisms. Quantitative polymerase chain reaction (PCR) is a genomic MBT that can identify the presence and activity of *Dehalococcoides spp*, a key microorganism in the reductive dechlorination of tetrachloroethene (PCE) and TCE.

MBT selection will depend on the questions that need to be answered. Tools are available to help answer:

- Are key microbes present?
- What is the microbial density?
- How active is the microbial community?
- What groups of microbes are present, and what is their total biomass?

- Can the contaminants be biologically degraded under site conditions?
- Are contaminants being degraded?

### Application of Molecular Biological Tools (MBTs)

MBTs can be used to prove the biodegradation of specific compounds; quantify total biomass and assess the microbial population; and rapidly detect and quantify specific microbial populations and processes. Greg Davis (Microbial Insights, Inc.) explained how the following MBTs work and their applications in environmental investigations:

- CENSUS<sup>®</sup> (quantitative PCR), an analysis of microbial communities in environmental media that works by counting genes.
- Terminal restriction fragment length polymorphisms, a DNA-based technique that provides a profile of the microbial community (identifies microorganisms to the genus level).
- 454 sequencing, a DNA-based technique that provides a more in-depth profile of the microbial community (identifies microorganisms to the genus level).
- Phospholipid fatty acid analysis, uses fatty acids as biomarkers to determine the number and types of cells present and what are they doing.

### Application of Bio-Trap<sup>®</sup> Samplers and Stable Isotope Probing

Kerry Sublette (University of Tulsa) explained that Bio-Trap<sup>®</sup> Samplers are passive sampling tools for collecting active microbes. They contain beads made of Nomex polymer and powdered activated carbon within which the microbes colonize. Deployment involves suspending the sampler from the well casing into the screened interval, typically in monitoring wells upgradient of the source area and down the center of the plume. Bio-Trap<sup>®</sup> Samplers provide an integrated sample, rather than a point-in-time sample. They can be used with MBTs and for chemical analyses (including chemical concentrations and CSIA).

Applications of Bio-Trap<sup>®</sup> Samplers include:

- Determining if known degraders of a contaminant are present.
- Evaluating MNA versus enhanced bioremediation.
- Comparing the effectiveness of amendments designed to stimulate bioremediation.
- Proving that bioremediation of a specific compound is occurring using stable isotope probing.

### Application of Stable Isotope Analysis to Understand Behavior of Chlorinated Solvents

John Wilson (GWERD) pointed out that the real use of CSIA is in the determination of the degradation rates of daughter products when the parent compound is gone. It would be inappropriate to use it for a contaminant distribution of one-third each of TCE, dichloroethene (DCE), and vinyl chloride (VC). He presented methods of calculation and comparison

for DCE and VC to evaluate the occurrence of natural attenuation in wells where total VOC concentrations were increasing rather than decreasing. Data interpretation issues were addressed, including estimation of the original (i.e., prior to degradation) value of the carbon isotope ratio for a contaminant and estimation of the enrichment factor, a key value used in calculating the extent of contaminant degradation. Reference to EPA's *A Guide for Assessing Biodegradation and Source Identification of Organic Ground Water Contaminants Using Compound Specific Isotope Analysis (CSIA)* is suggested for more detailed information on the topic.

## Performance Evaluation: Permeable Mulch Biowall for Enhanced Bioremediation of Chlorinated Ethenes

Joseph Haas (Environmental Scientist with New York State Office of the Attorney General, Environmental Protection Bureau) described the attempts to measure the performance of a mulch biowall installed to reduce concentrations of chlorinated ethenes in groundwater to levels protective of ecological risks at a site and decrease the timeframe for MNA. An initial performance evaluation suggested that the wall was inducing conditions suitable to reductively dechlorinate TCE to *cis*-DCE, and that *cis*-DCE was decreasing with no accumulation of VC. However, additional information was needed to confirm that the decrease in contaminant concentrations across the biowall was indeed due to reductive dechlorination or another destructive process. Finally, CSIA was conducted to measure the ratio of  $^{12}\text{C}$  to  $^{13}\text{C}$  within the dissolved TCE both upgradient and downgradient of the biowall. The results of CSIA provided definitive confirmation that as much as a 50% of the TCE concentration reduction across the biowall was the result of reductive dechlorination or another destructive process. The investigation concluded that the overall attenuation rate attributed to biodegradation and/or abiotic degradation processes is near 0.2 per year. Additional analyses of the biowall performance based upon the study of groundwater flow through the biowall, additional contaminant distribution data and laboratory column experiments with biowall materials, where TCE removal rates were measured consistent with the reductions observed in the field, again suggested that the biowall was performing as intended but failed to conclusively prove that the observed decrease in contamination was due to reductive dechlorination or another destructive process.

## Opportunities to Integrate New Tools such as MBT and CSIA into Existing Policy and Guidance for Selection, Design and Performance Monitoring of Remedies at Chlorinated Solvent Sites

Herb Levine (Region 9) pointed out the need to integrate advanced tools such as MBT and CSIA into EPA's MNA policy to complement the techniques currently used. Tier 3 of the three-tiered approach for demonstrating MNA involves

## Welcome New Co-Chairs

Congratulations to Andrew Schmidt (Region 8), Suzanne Davis (California DTSC), and Sandra Bourgeois (Region 8), who were recently elected co-chairs of the Ground Water Forum, Engineering Forum, and Federal Facility Forum, respectively. They replace outgoing co-chairs Greg Lyssy, Raji Josiam (both of Region 6), and Clint Sperry (Region 7), who were acknowledged with certificates of appreciation at the meeting. Thank you all for your continued service to the TSP!

direct measurements of field data and in situ microcosm studies. Herb recommended incorporating CSIA and MBT into Tier 3 to help determine whether contaminants are degrading, the mechanisms of degradation, and their sustainability over time. A case study highlighted a dry cleaner site in California at which CSIA and MBT were proposed to determine whether MNA of site PCE was due to biodegradation. Upon further scrutiny, it was determined that the requirements of Tiers 1 and 2 had not been satisfied because data had not yet shown a decreasing mass or concentration over time. Therefore, this particular investigation was not yet ready for the use of advanced tools.

## Overview of Geophysics for Environmental Site Characterization and Monitoring

Carlyle Miller (GWERD) summarized the pros and cons of a number of geophysical methods for characterizing the subsurface, including direct current resistivity, seismic reflection and refraction, frequency domain electromagnetics (EM), ground-penetrating radar, gravity, and magnetics. He explained the types of information that each method can provide, including specific examples where geophysics helped to:

- Characterize a geothermal resource and identify possible drilling targets.
- Verify emplacement of zero valent iron in a redox manipulation barrier.
- Characterize a construction site and identify possible karst sinkhole features or other hazards.
- Determine seasonal variability in water storage for a small watershed.
- Characterize a geothermal system.

Carlyle recommended [www.enviroscan.com/html/technique\\_selection.html](http://www.enviroscan.com/html/technique_selection.html) as a helpful website for selecting the appropriate geophysical method(s).

## The Use of Resistivity to Aid in the Development of the Remedial Action Groundwater Monitoring Program

Bernie Zavala (Region 10) presented a case study illustrating the successful use of a resistivity survey at a site in Idaho

contaminated with sulfate, orthophosphate, and arsenic. The resistivity survey was selected to further delineate the lateral and vertical extent of the contaminant plume as well as provide information to inform placement of performance assessment monitoring wells and compliance points in the area prior to discharge into a nearby river. The results of the survey were ground truthed through use of a sonic rig to do vertical profile sampling. The samples were analyzed in the field using Hach test kits for sulfate and phosphorus. The results were used to select the screened intervals and number of wells per location. Bernie received assistance in reviewing the work plan for this project from Dale Werkema of EPA's Technical Support Center for Characterization and Monitoring in Las Vegas.

## **An Approach to Evaluating the Progress of Natural Attenuation in Groundwater**

John Wilson (GWERD) presented a simple, statistically based approach for evaluating the progress of natural attenuation from data collected during site characterization and long-term monitoring. He pointed out that statistics cannot be used to prove that something (e.g., datasets collected at different times) is the same or that attenuation is adequate to meet the goal; instead, statistics can be used to prove that something is different with a predetermined possibility of error and to test if attenuation is not adequate to meet the goal at some level of confidence. The following decision criterion can be used to determine if attenuation is adequate to meet the long term goal: "If the mean of the interim goals in the final year of the review cycle is less than the mean of the samples in the final year at some predetermined level of confidence, then attenuation will not be adequate to attain the goal." Guidance and spreadsheets to assist in this assessment are available at [www.epa.gov/nrmrl/pubs/600r11204.html](http://www.epa.gov/nrmrl/pubs/600r11204.html).

## **Predicting DNAPL Source Zone and Plume Response Using Site-Measured Characteristics**

Lynn Wood and Michael Brooks (GWERD) indicated that predicting the relationship between DNAPL source-zone changes and downgradient plume response is critical to making informed site management decisions—especially those related to remedial actions. Thus, it is vital to conduct source zone and plume characterization within a framework that is consistent with appropriate predictive models. They are participants in Strategic Environmental Research and Development Program (SERDP) Project ER-1613, which is focused on estimating the source-strength function from historical site data, supplemented with limited flux- and core-based sampling, for site management purposes. Based on previous characterization of the source zone architecture, the goal is to extend the ability to predict DNAPL source depletion through dissolution at field scale. Additionally, the project will characterize near-source plume response to source-mass depletion to help predict long-term plume



responses and link characterization of the near-source, short-term responses to likely long-term behavior of the dissolved plume. The knowledge gained from the field site data and experiments will be synthesized to provide guidance on the recommended level of source zone characterization needed to predict source-strength functions and plume response. The presentation covered a flux-based site management case study from the Naval Construction Battalion Center in Rhode Island, including results from an analysis of mass discharge measurement uncertainty and methods for factoring back diffusion into flux-based site management.

## **FEDERAL FACILITIES**

### **Update from EPA's Federal Facilities Restoration and Reuse Office (FFRRO)**

Reggie Cheatham (Director, FFRRO) said that although FFRRO's budget decreased significantly in FY 12, which limited work mainly to NPL sites, a small budget increase is projected for FY 13 to support post-construction activities, such as five-year reviews. Future Department of Defense (DoD) investments are uncertain, however, as resources for BRAC I through IV will decrease while Congress discusses the potential for additional BRAC (Base Realignment and Closure) rounds for 2013 and 2015. The BRAC memorandum of understanding expires in 2016, and there are no plans to extend it.

FFRRO is updating its 2005 *Handbook on the Management of Munitions Response Actions*. In March 2012, DoD issued a guidance update for managing cleanup activities under the Defense Environmental Restoration Program (DERP). FFRRO is reviewing DERP manual inconsistencies with EPA policies (e.g., when munitions become a waste and hazardous substance). Where the DERP manual is inconsistent with a corresponding EPA provision, the EPA provision must be used. If the manual is cited to challenge EPA policy, RPMs should inform FFRRO and FFEO as soon as possible.

FFRRO and Regions 1, 2, 9, and 10 formed a short-term workgroup to evaluate current FFRRO performance measures and to develop innovative measures that track or demonstrate critical program accomplishments. The ultimate

goal is to draft recommendations for OSWER senior management and OMB aimed for FY 14 and beyond. Headquarters and regional volunteers are working with the Superfund Enterprise Management System (SEMS) development team to scope federal facility business processes and system needs. When SEMS replaces CERCLIS, it will incorporate all aspects of the Superfund Program, including budgeting, cost recovery, and land reuse. An effort is underway in Region 7 to pilot test the use of SEMS in site management. At GAO's recommendation, EPA regional offices are tracking review times in FY 12 for major decision and review documents associated with DoD NPL facilities. FFRRO will compile the regional data at the end of the fiscal year and submit national numbers to GAO.

In response to stakeholder input from the Federal Facility Cleanup Dialogue meetings, FFRRO is developing webinars to disseminate information about cleanup progress at federal sites. The five-year review workgroup has drafted a template for federal facility five-year reviews and is working on training modules to promote consistency in writing and reviewing reports, and a community video on five-year reviews. The Federal Mining Dialogue (FMD) is a new, cooperative initiative among federal environmental and land management agencies that provides a national forum for federal agencies to identify, discuss, and clarify key policy, regulatory, and technical issues associated with the cleanup and reuse of abandoned or inactive hard rock mine and mineral processing sites. The FMD is preparing a communication strategy and a charter for the member federal agencies.

### **Update from the Federal Facilities Enforcement Office (FFEO)**

Dave Kling (FFEO) pointed out that FFEO entered a record number of CERCLA formal disputes in 2011, which demonstrates the Agency's resolve to affirm protectiveness. It is vital for RPMs to inform FFEO immediately whenever a formal dispute is contemplated to allow early coordination with Regional counsel, OSWER, and the Office of General Counsel. When informal discussions stall, elevating the matter to formal dispute is an effective course, as formal disputes and penalties help EPA assure quality cleanups. It also is important to adhere to the federal facility agreement (FFA) dispute timelines and coordinate closely with FFEO throughout the process.

In accordance with the model FFA language negotiated with DoD and the Department of Energy, "any language which leads to or generates a dispute" can be subject to the FFA's dispute provision. Stuart Hunt and Sally Dalzell (FFEO) provided brief summaries of six recently resolved FFA disputes to illustrate the process and highlight the utility of the "model letter" for stipulated penalties. Any participant in an FFA can initiate the dispute. Three of the example disputes were initiated by the affected states.

FFEO faces many challenges in effective performance of its mission to protect human health and the environment: budget constraints, federal agency resistance to EPA and state environmental authority, other federal agency mission activities, difficult technical issues and emerging contaminants, and cleanups at remote sites, such as abandoned mines.

### **Cleanup at Sunflower Army Ammunition Plant in De Soto, Kansas**

Jim Stevens and Ken Herstowski (Region 7) discussed some of the difficulties in the cleanup of an extensive facility where explosives constituents, metals, and organic compounds remain from prior army activities. Current redevelopment plans anticipate mostly unrestricted (residential) use of a roughly 15-square-mile area that contains 2,500 buildings and storage bunkers. Most buildings are in poor condition or unsuitable for reuse and will be demolished. EPA and the Kansas Department of Health and Environment are not requiring immediate demolition of buildings and excavation of contaminated soils, but they are requiring that as buildings are demolished or land disturbance around the buildings occurs for any reason, the soils must be properly managed to ensure the area is safe for the intended end use. Pesticides in soils around buildings that will be demolished would no longer serve their original purpose, and thus could be considered a solid waste. RCRA Section 3004(u) requires corrective action for releases of hazardous waste or constituents from any solid waste management unit at a RCRA permitted facility.

EPA has limited sampling data from the developer on just three buildings, where pesticide levels are up to 300 times higher than risk-based levels. Building footprints require cleanup for explosives constituents, asbestos, lead, and pesticides. In the past, contaminated soil has been hauled offsite to a landfill. Ken discussed the ramifications of three cleanup options to reduce future cleanup expenses: a) onsite disposal of cleanup waste, b) onsite treatment of pesticide soil, and c) risk assessment and focused cleanup.

## **CASE STUDIES**

### **Designing a Mass-Flux Baseline Study for a Site with Hydrogeologic Conceptual Model and Mass Transfer Mysteries**

The Hamilton/Labree Roads Superfund Site in Washington has two known primary areas where PCE was released into soil and surface water, resulting in a DNAPL source at the Hamilton Road Impact Area (HRIA) and a lesser source at the S.C. Breen Construction Company property. Contaminated groundwater plumes from these areas comeingle and flow west and northwest generally along Berwick and Dillenbaugh Creeks in the Newaukum River Valley. Marcia Knadle (Region 10) found that the available boring and well data were very clustered, much of it flawed and difficult to compare, and

most of it over eight years old. A mass flux baseline study is proposed to evaluate the performance of a planned HRIA source zone cleanup, improve the hydrogeologic conceptual site model, and assist in evaluating the relative contribution of each source to the plume and plume extent. The proposed approach for measuring mass flux would involve transects of multi-level wells or clusters. Marcia discussed the site's background, characteristics, investigation history, and design considerations for conducting the mass flux study.

### **Fort Devens Superfund Site: A Technical Support Success Story**

Steve Acree (GWERD) discussed a successful applied research project in the Red Cove area at Shepley's Hill Landfill, Fort Devens, Massachusetts. Leachate leaking from Shepley's Hill Landfill has resulted in high arsenic concentrations in groundwater. Region 1 characterization using a variety of tools indicated groundwater discharge as a likely significant and continuing source of arsenic to the Red Cove area of an adjacent pond. The project characterization goal was to identify mobile forms of arsenic in groundwater, identify processes controlling arsenic uptake onto Red Cove sediments, and evaluate arsenic stability in the sediments.

Patterns in sediment temperature and potassium concentration distribution in shallow groundwater underlying Red Cove generally aligned with the estimated distribution of contaminated groundwater discharge into the cove. The elevated concentration of potassium in deep surface water appeared to be an indicator for plume discharge. General correspondence was observed between the locations of highest sediment arsenic concentrations and suspected locations of contaminated groundwater discharge. In sediments, the reduced form of arsenic was found to be dominant in areas where significant groundwater discharge was indicated. Thanks to teamwork, shared resources, effective Region 1 project management, and a cooperative site owner, benefits of this highly successful project included the development and field testing of a ruggedized advective flux meter, remediation plans for Red Cove sediments and groundwater discharge, and several project awards.

### **Steam Enhanced Extraction to Remediate a Large Jet Fuel Spill at the Former Williams AFB**

Eva Davis (GWERD) provided a case study of a thermally enhanced extraction (TEE) pilot test conducted by the Air Force at the former Williams AFB, a large site with fuel LNAPL extending to approximately 240 feet below ground surface. TEE, a variation of steam enhanced extraction (SEE), injects steam into central injection wells and extracts steam, groundwater, and NAPL at peripheral extraction wells. (SEE introduces steam through multiple peripheral wells to generate a front that moves contaminants toward centrally located extraction well(s) within the source area.)

The design for this site included two vertically stacked injection wells within the source area encircled by six pairs of extraction wells to treat a vertical extent of about 70 feet.

The steam injection portion of the pilot test operated from October 2008 through February 2009 to evaluate the effectiveness of TEE to reduce the mass of a jet fuel source in the saturated zone. The Air Force estimates the source zone to comprise hundreds of thousands of gallons, while EPA estimates between 3 and 12 million gallons. Injection of approximately 12 million pounds of steam helped to remove 4,000 pounds of benzene and 117,902 pounds of petroleum hydrocarbons (PHC), of which half was recovered as NAPL. PHC extraction rates increased from 10.9 lbs/day during groundwater extraction alone to 961 lbs/day during the steam injection. It is difficult to determine effectiveness or residual mass from a pilot test as the test was not optimized and recontamination from outside occurred. However, the pilot demonstrated that steam can be injected successfully into the site to significantly enhance the recovery of PHC and benzene. Under a newly-awarded performance based contract, the new site contractor has proposed full-scale SEE for this operable unit. SEE is generally the most cost-effective thermal technology for large, deep sites.

## **GROUNDWATER MODELING**

### **Groundwater Modeling: Lessons Learned from over Two Decades of Technical Assistance**

Milovan Beljin (M.S. Beljin & Associates) defined a model as a "selected simplified version of a real system that approximately simulates the behavior of the system." It is a tool for obtaining a better understanding of the system and predicting future behavior with respect to its geology, hydrology, and chemistry. When Milovan co-authored [with Randall Ross (GWERD) and Jacob Bear (Israel Institute of Technology)] the issue paper entitled *Fundamentals of Ground-Water Modeling* in 1992, environmental modeling was still a young science. He pointed out that the rapid development of more sophisticated tools can create a modeling disconnect: whereas older, experienced professionals may be unfamiliar with the use of new, increasingly complex models, the young, computer-literate professionals who run them lack the professional experience to use the models effectively. Output from models is not a substitute for expert knowledge. Milovan addressed modeling objectives and the modeling process, and provided examples of experiences in groundwater modeling gained over the course of 20 years.

### **Streamline and Capture Zone Modeling**

Jim Weaver (GWERD) discussed Sustainable and Healthy Communities Program research initiatives in which EPA researchers and their partners and stakeholders work

## National Strategy to Expand Superfund Optimization from Site Assessment to Site Completion

Kira Lynch (Superfund and Technology Liaison, Region 10) reported that EPA OSRTI and representatives from the regional offices and ORD are close to finalizing a National Strategy to Expand Superfund Optimization from Site Assessment to Site Completion. The strategy encourages overarching process changes in remedial program management and implementation and site level project management. These changes are intended to instill routine and frequent assessment of site cleanup progress, technical performance and costs, and refine business practices including acquisition strategies and contracts management. The strategy also encourages incorporating optimization principles throughout the cleanup process from site assessment through site completion.

OSRTI's goal is to conduct independent optimization reviews at 20 to 30 sites annually. In FY 2012, a total of 31 sites have been supported to date, with 32% of those sites in remedial investigation, feasibility study, or remedial design phases. For more information on optimization and the strategy, visit [www.cluin.org/optimization](http://www.cluin.org/optimization) or [www.epa.gov/superfund/cleanup/postconstruction/optimize.htm](http://www.epa.gov/superfund/cleanup/postconstruction/optimize.htm) or contact your Regional Optimization Liaison - listed below:

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together on projects that foster protection of human health and the environment. His particular area of interest, advanced transport modeling using streamline-based approaches, falls under the research theme of “near-term approaches for sustainable solutions.” Two approaches are being developed. The first is based on analytical solutions for groundwater flow and contaminant transport. Although useful for quick analyses, these are limited to very simple, homogeneous aquifers. The second solution extends the approach using numerical models to overcome these limitations. Jim’s solution technique comprises a combination of established techniques and provides a method where no matrix equations are used, non-linear problems are easily solved, particle tracking is not needed, numerical dispersion is minimized, and large time steps can be used. Grid refinement further reduces unnecessary calculation. He has tested the technique on three problems at three scales: 1) nanoparticle transport in lab column studies—coupled non-linear equations (15-cm scale); 2) lead scavengers in gasoline-NAPL dissolution (100-m scale); and 3) ethanol spills to rivers—reactive transport (50,000-m scale). Additional information on the Sustainable and Healthy Communities Program is available on the EPA Intranet.

## FIELD SAMPLING AND INSTRUMENTATION

### Passive Soil Gas Sampling

Harry O’Neill (Beacon Environmental Services) proposed passive soil gas (PSG) sampling as a cost effective approach to identify source areas and vapor intrusion pathways, delineate contaminant plumes, and optimize remediation systems. The PSG samplers are made of inert materials, and each one contains an equal measured amount of hydrophobic adsorbent. PSG surveys typically consist of rapid deployment of dozens to hundreds of samplers to a depth of 6 inches to 3 feet in a grid pattern, with field exposure ranging from three days to two weeks. The passive adsorption of organic soil gas compounds can yield a more representative sample than active soil gas methods, and sampling all locations at the same time allows normalization of hourly or daily temporal variations in soil gas concentrations. PSG samples are analyzed following EPA Method 8260B, using thermal desorption gas chromatograph and mass spectrometer (GC/MS). PSG data are not used for determining concentration, but reporting data in units of

mass (nanograms or micrograms) meets project objectives to characterize sites and guide where to collect a limited number of soil, groundwater, or active soil gas samples.

## Phytoforensics: Soil and Groundwater Data without Soil or Groundwater

Joel Burken (Missouri University of Science and Technology) is collaborating with others to develop innovative plant-based sampling technologies, called "phytoscreening," to assess subsurface soil and groundwater contamination. The method has been tested at more than 40 contaminated sites and can be useful for monitoring the progress of long-term remedies, such as natural attenuation or enhanced reductive dechlorination. Dendrochemistry is the applied analysis of tree rings to provide information regarding the timing of past environmental incidents. Combined, these methods represent "phytoforensic" techniques, which provide a current and historical record of contamination.

Tree coring is the backbone of phytoforensics. Each core taken from a tree is about the thickness of a pencil to a depth of 6 to 10 cm, depending on the size of the tree. Mobilization requires one small tool bag and vials to contain the cores for transport to the laboratory. At an old railroad yard, a four-person crew obtained 114 samples in one day. The tree core data provided the extent and locations of contamination more accurately than the data acquired during 12 years of testing in 40 monitoring wells. Previously unrecognized areas of groundwater contamination found with the tree-coring data were verified via direct push techniques. Sample data and locations can be entered on a mobile device and used to guide field work.

*In planta* sampling techniques allow rapid acquisition of sample data in the field. One approach uses a solid-phase microextraction (SPME) fiber that is inserted into a tree to detect traces of chemicals at minute levels—as little as 1 part per trillion of TCE within the plant. The *in planta* devices allow the sampler to use the same hole, or port, in the tree for each sampling event. The device can be connected to a field GC/MS for direct analysis. Solid-phase samplers, which employ polymers as passive diffusion samplers *in planta* to accumulate contaminants, are more sensitive than SPME. Currently, phytoforensics technology is being adapted to detect trace amounts of explosives constituents, including perchlorate, in tree sap using a novel centrifugal sampling method.

## Demonstration of HAPSITE Instrument

Chris Villarreal (Region 6) demonstrated the operation of a portable GC/MS called a HAPSITE unit. Designed for field analysis of VOCs in near real time, the rugged analyzer weighs about 35 pounds and is as accurate as a standard laboratory GC/MS. Survey mode, using MS only, can provide a quick, tentative analysis to identify an unknown chemical and enable the screening of numerous samples in a short period of time.

Survey mode requires a sample concentration greater than 1 ppm, whereas full analytical mode using both the GC and MS detects at lower concentrations and identifies samples that were inconclusive in survey mode or are present in mixtures. Coupling the instrument with a laptop computer and an internal GPS unit, Chris plans to take the system into the field to gain practical experience with its use (e.g., to determine how many samples can be run per gas canister). Chris noted that the rapid HAPSITE analyses are particularly useful for vapor intrusion screening because they enable the operator to provide home and business owners with same-day updates rather than weeks-later reports.

## Low-Cost Electronic Nose for Groundwater Contaminants

Bill Tolley (Seacoast Science, Inc.) described the development of innovative low-cost sensor systems designed to detect and monitor chlorinated solvents in the subsurface and groundwater, unattended and in real time from within a push probe. The "electronic nose" uses a MEMS (micro-electro-mechanical system) microcapacitor sensor array with a proprietary trap-and-purge preconcentrator to detect chlorinated solvent vapors. The sensor arrays are filled with several chemoselective polymers whose dielectric permittivity changes when exposed to different vapors, creating a fingerprint response for each chemical. The system can be programmed to monitor at intervals of minutes, hours, or days, which is potentially useful for tracking fluctuations in contaminant levels (e.g., in indoor air). In Phase 1 of a Small Business Innovation Research (SBIR) project funded by the National Institute of Environmental Health Sciences, the company successfully demonstrated the feasibility of using the sensor to detect TCE and trichloroethane (TCA) at levels low enough to meet EPA-mandated levels for drinking water. In Phase II, Seacoast is improving the system's selectivity and sensitivity.

## Field Deployable Vapor Intrusion Monitor

Bikas Vaidya (Lynntech) discussed the development of a compact, light-weight, and easy-to-operate vapor intrusion monitor capable of providing rapid test results. The work is supported by a 2011 SBIR Phase 1 grant from the NIEHS Superfund Research Program. The technology combines solid-phase extraction for selective capture and pre-concentration of volatile and semi-volatile toxic chemicals with infrared fingerprinting for unambiguous identification of the analytes. The device can be used both inside and outside a building to monitor chemicals such as TCE, PCE, polycyclic aromatic hydrocarbons, and polybrominated biphenyls. It is designed to log and transmit data and to operate for extended periods without intervention. In its current state of development, the monitor's limit of detection is less than 10 ppb for PCE and less than 20 ppb for TCE, with 20 minutes capture at 1 liter per minute. The limit can be improved by increasing the sample volume through flow rate and capture time adjustment.

## NEW RESOURCES

### Rare Earth Minerals Mining

Robert Weber (Region 7 Superfund and Technology Liaison) explained that the 17 rare earth elements (REEs) of the periodic table are not actually rare—they occur in far greater concentrations than gold or silver—but typically are dispersed within a matrix of other minerals and are not found in elemental forms. REEs have many technology and defense applications due to their unique magnetic, optical, catalytic and other chemical and metallurgical properties. EPA's National Risk Management Research Laboratory through its Engineering Technical Support Center in Cincinnati has developed the document, *Rare Earth Elements: A Review of Production, Processing, Recycling, and Associated Environmental Issues*, to serve as a technical information resource to policy makers and other stakeholders concerned with the potential environmental and health effects and impacts that can be identified across the REE supply chain. Based on anticipated, proposed, or past practices, this document attempts to identify the environmental compartments (i.e., aquatic environment, terrestrial environment, and air) that may be at risk. It also attempts to identify the corresponding environmental loads (e.g., raw material consumption, air emissions, water discharges, wastes) when that information is available in the literature or an association can be made with anticipated, current, and past practices. The document is currently in the Agency's internal and administrative review.

### Emerging Contaminants Update

Marlene Berg and Michele Burgess (OSRTI) reported that within the past year, new information has been posted to EPA's Integrated Risk Information System (IRIS) for 2,3,7,8-tetrachlorodibenzo-p-dioxin (dioxin), TCE, and PCE. EPA also released the [Dioxin Tool Box](#), a compilation of technical documents intended to assist Superfund project managers in the sampling and analysis of dioxin contaminated soils, alongside a technical report and its peer review comments, *Bioavailability of Dioxin and Dioxin-like Compounds in Soil*. The most immediate impact of the TCE risk assessment update is that Superfund has updated the Regional Screening Levels. The Centers for Disease Control and Prevention recently made recommendations regarding the level of lead in blood that will trigger medical monitoring and other actions in children ages 1 to 5. The recommendation states that any blood lead level has an affect on a child's health. The current reference value is 5 micrograms per deciliter of lead in a child's blood, which is based upon the 97.5<sup>th</sup> percentile of National Health and Nutrition Examination Survey data. Concurrently, EPA's Children's Health Protection Advisory Committee has made recommendations to the EPA Administrator that includes an update to the new Integrated Exposure Uptake Biokinetic Model for estimating

children's blood lead levels. In response to recent concerns with the relative toxicity of the six isomers of dinitrotoluene (DNT), which are associated with munitions production, EPA ORD plans to release a provisional peer reviewed toxicity value for 2,6-DNT in spring 2012 and technical grade DNT in fall 2012.

### Groundwater Sampling at ISCO Sites – Oxidant Residuals and Sample Preservation Guidelines

Due to oxidant persistence during in situ chemical oxidation (ISCO), groundwater samples collected at hazardous waste sites may contain a “binary mixture” of the contaminant(s) and oxidant. Scott Huling (GWERD) explained that the commingling of organic contaminants and oxidant residuals in groundwater samples is mainly the result of heterogeneities in aquifer materials, and consequently, the heterogeneous distribution of oxidants and contaminants. Groundwater solutes can enter a monitoring well screen from different lithologic zones, containing different concentrations of oxidants and contaminants. The effects of binary mixtures also extend to bench-scale studies where residual oxidants occur in laboratory reactors and aqueous samples are collected and analyzed for VOCs. Assuming an oxidant is present in either groundwater or bench-scale aqueous samples and the binary sample is not appropriately detected and preserved, the quality of the sample is likely to be compromised. Examples of preservation approaches for binary mixtures containing persulfate and permanganate oxidants were presented.

## Technical Support Project Regional Contacts

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